

What is claimed is:

1. An electrolytic processing apparatus comprising:
a substrate holder for holding a substrate;

5 a first electrode for bringing into contact with
the substrate to supply current to a surface, to be
processed, of the substrate;

a second electrode disposed substantially parallel
to the surface, to be processed, of the substrate in a
10 position facing the surface, to be processed, of the
substrate held by said substrate holder;

a high resistance structure disposed between the
substrate held by said substrate holder and said second
electrode;

15 an electrolytic solution introducing portion for
introducing an electrolytic solution into a region across
which the substrate held by said substrate holder and said
high resistance structure face each other, from laterally of
said high resistance structure; and

20 a power source for applying a voltage between said
first electrode and said second electrode.

2. An electrolytic processing apparatus according
to claim 1, further comprising:

25 an electrode holder which holds said second
electrode and said high resistance structure;

wherein said electrolytic solution introducing
portion is provided through said electrode holder.

3. An electrolytic processing apparatus according to claim 1, further comprising:

an electrode holder which holds said second
5 electrode and said high resistance structure;

wherein said electrolytic solution introducing portion is disposed laterally of said electrode holder.

4. An electrolytic processing apparatus according
10 to claim 1, further comprising:

an air ejecting portion for ejecting air to the region across which the substrate held by said substrate holder and said high resistance structure face each other.

15 5. An electrolytic processing apparatus according to claim 1, further comprising:

an air drawing portion for drawing air from the region across which the substrate held by said substrate holder and said high resistance structure face each other.

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6. An electrolytic processing apparatus according to claim 1, wherein said high resistance structure is vertically movable and tiltable, and wherein said high resistance structure is tilted, and while the electrolytic
25 solution is being introduced into the region across which the substrate held by said substrate holder and said high resistance structure face each other from a side where the substrate held by said substrate holder and said high

resistance structure are closest to each other, said high resistance structure is lowered back to a horizontal state.

7. An electrolytic processing apparatus according
5 to claim 1, wherein said high resistance structure is horizontally held and vertically movable, and wherein while the electrolytic solution is being introduced into the region across which the substrate horizontally held by said substrate holder and said high resistance structure face
10 each other, said high resistance structure is lowered.

8. An electrolytic processing apparatus according to claim 1, further comprising:

a deaerating device for removing a dissolved gas
15 from the electrolytic solution which is introduced from said electrolytic solution introducing portion.

9. An electrolytic processing apparatus according to claim 1, wherein said electrolytic solution introducing
20 portion has a distal end shaped as a nozzle or a slit.

10. An electrolytic processing apparatus according to claim 1, wherein a check valve is disposed in said electrolytic solution introducing portion or a porous member
25 is filled in said electrolytic solution introducing portion.

11. An electrolytic processing apparatus according to claim 1, wherein said electrolytic solution introducing

portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

5 12. An electrolytic processing apparatus according to claim 1, wherein said electrolytic solution introducing portion is disposed in positions facing each other across the substrate held by said substrate holder.

10 13. An electrolytic processing apparatus according to claim 1, wherein said substrate holder is rotatable, and the electrolytic solution is introduced from said electrolytic solution introducing portion while said substrate holder is rotated together with the substrate.

15 14. An electrolytic processing apparatus according to claim 1, wherein said electrolytic solution introducing portion has a plurality of liquid delivery pumps for delivering the electrolytic solution at spaced time
20 intervals.

 15. An electrolytic processing apparatus according to claim 1, wherein the electrolytic solution is introduced from said electrolytic solution introducing portion at a
25 linear speed ranging from 0.1 to 10 m/sec., and the introduction of the electrolytic solution over the substrate is completed within 5 seconds.

16. An electrolytic processing apparatus comprising:

a substrate holder for holding a substrate;

5 a first electrode for bringing into contact with the substrate to supply current to a surface, to be processed, of the substrate;

a second electrode disposed substantially parallel to the surface, to be processed, of the substrate in a position facing the surface, to be processed, of the
10 substrate held by said substrate holder;

an electrolytic solution introducing portion for introducing an electrolytic solution into a region between the substrate held by said substrate holder and said second electrode, from laterally of the substrate; and

15 a power source for applying a voltage between said first electrode and said second electrode.

17. An electrolytic processing apparatus according to claim 16, further comprising:

20 a deaerating device for removing a dissolved gas from the electrolytic solution which is introduced from said electrolytic solution introducing portion.

18. An electrolytic processing apparatus according to claim 16, wherein said electrolytic solution introducing
25 portion has a distal end shaped as a nozzle or a slit.

19. An electrolytic processing apparatus according to claim 16, wherein a check valve is disposed in said electrolytic solution introducing portion or a porous member is filled in said electrolytic solution introducing portion.

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20. An electrolytic processing apparatus according to claim 16, wherein said electrolytic solution introducing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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21. An electrolytic processing apparatus according to claim 16, wherein said electrolytic solution introducing portion is disposed in positions facing each other across the substrate held by said substrate holder.

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22. An electrolytic processing apparatus according to claim 16, wherein said substrate holder is rotatable, and the electrolytic solution is introduced from said electrolytic solution introducing portion while said substrate holder is rotated together with the substrate.

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23. An electrolytic processing apparatus according to claim 16, wherein said electrolytic solution introducing portion has a plurality of liquid delivery pumps for delivering the electrolytic solution at spaced time intervals.

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24. An electrolytic processing apparatus according to claim 16, wherein the electrolytic solution is introduced from said electrolytic solution introducing portion at a linear speed ranging from 0.1 to 10 m/sec., and the introduction of the electrolytic solution over the substrate is completed within 5 seconds.

25. An electrolytic processing apparatus comprising:

10 a substrate holder for holding a substrate;
a first electrode for bringing into contact with the substrate to supply current to a surface, to be processed, of the substrate;

15 a second electrode disposed substantially parallel to the surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder;

20 a high resistance structure disposed between the substrate held by said substrate holder and said second electrode;

an electrolytic solution circulating system having an electrolytic solution introducing portion for introducing an electrolytic solution into a region across which the substrate held by said substrate holder and said high resistance structure face each other, from laterally of said high resistance structure, and an electrolytic solution drawing portion for drawing for circulation the electrolytic

solution introduced into said region, from laterally of said high resistance structure; and

a power source for applying a voltage between said first electrode and said second electrode.

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26. An electrolytic processing apparatus according to claim 25, further comprising:

an electrode holder which holds said second electrode and said high resistance structure;

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wherein at least one of said electrolytic solution introducing portion and said electrolytic solution drawing portion is disposed through said electrode holder.

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27. An electrolytic processing apparatus according to claim 25, further comprising:

an electrode holder which holds said second electrode and said high resistance structure;

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wherein at least one of said electrolytic solution introducing portion and said electrolytic solution drawing portion is disposed laterally of said electrode holder.

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28. An electrolytic processing apparatus according to claim 25, wherein said electrolytic solution circulating system has a deaerating device for removing a dissolved gas from the electrolytic solution in circulation.

29. An electrolytic processing apparatus according to claim 25, wherein said electrolytic solution introducing

portion and/or said electrolytic solution drawing portion has a distal end shaped as a nozzle or a slit.

30. An electrolytic processing apparatus according to claim 25, wherein a check valve is disposed in said electrolytic solution introducing portion or a porous member is filled in said electrolytic solution introducing portion.

31. An electrolytic processing apparatus according to claim 25, wherein at least one of said electrolytic solution introducing portion and said electrolytic solution drawing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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32. An electrolytic processing apparatus according to claim 25, wherein said electrolytic solution introducing portion and said electrolytic solution drawing portion are disposed in positions facing each other across the substrate held by said substrate holder.

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33. An electrolytic processing apparatus comprising:

a substrate holder for holding a substrate;

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a first electrode for bringing into contact with the substrate to supply current to a surface, to be processed, of the substrate;

a second electrode disposed substantially parallel to the surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder;

5 an electrolytic solution circulating system having an electrolytic solution introducing portion for introducing an electrolytic solution into a region between the substrate held by said substrate holder and said second electrode, from laterally of the substrate, and an electrolytic
10 solution drawing portion for drawing for circulation the electrolytic solution introduced into said region, from laterally of the substrate; and

a power source for applying a voltage between said first electrode and said second electrode.

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34. An electrolytic processing apparatus according to claim 33, wherein said electrolytic solution circulating system has a deaerating device for removing a dissolved gas from the electrolytic solution in circulation.

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35. An electrolytic processing apparatus according to claim 33, wherein said electrolytic solution introducing portion and/or said electrolytic solution drawing portion has a distal end shaped as a nozzle or a slit.

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36. An electrolytic processing apparatus according to claim 33, wherein a check valve is disposed in said

electrolytic solution introducing portion or a porous member is filled in said electrolytic solution introducing portion.

37. An electrolytic processing apparatus according to claim 33, wherein at least one of said electrolytic solution introducing portion and said electrolytic solution drawing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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38. An electrolytic processing apparatus according to claim 33, wherein said electrolytic solution introducing portion and said electrolytic solution drawing portion are disposed in positions facing each other across the substrate held by said substrate holder.

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39. A substrate processing apparatus comprising:

a substrate holder for holding a substrate;

a member disposed substantially parallel to a surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder;

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a liquid introducing portion for introducing a liquid into a region across which the substrate held by said substrate holder and said member face each other, from laterally of said member; and

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an air ejecting portion for ejecting air to the region across which the substrate held by said substrate

holder and said member face each other, and/or an air drawing portion for drawing air from said region.

40. A substrate processing apparatus comprising:

5 a substrate holder for holding a substrate;

a member disposed substantially parallel to a surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder; and

10 a liquid introducing portion for introducing a liquid into a region across which the substrate held by said substrate holder and said member face each other, from laterally of said member;

wherein said member is vertically movable and
15 tiltable, and wherein said member is tilted, and while the liquid is being introduced into the region across which the substrate held by said substrate holder and said member face each other from a side where the substrate held by said substrate holder and said member are closest to each other,
20 said member is lowered back to a horizontal state.

41. A substrate processing apparatus according to claim 40, further comprising:

a member holder for holding said member;

25 wherein said liquid introducing portion is provided through said member holder or disposed laterally of said member holder.

42. A substrate processing apparatus according to claim 40, further comprising:

5 a deaerating device for removing a dissolved gas from the liquid introduced from said liquid introducing portion.

43. A substrate processing apparatus according to claim 40, wherein said liquid introducing portion has a distal end shaped as a nozzle or a slit.

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44. A substrate processing apparatus according to claim 40, wherein said liquid introducing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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45. A substrate processing apparatus according to claim 40, wherein said liquid introducing portion is disposed in positions facing each other across the substrate held by said substrate holder.

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46. A substrate processing apparatus according to claim 40, wherein said substrate holder is rotatable, and the liquid is introduced from said liquid introducing portion while said substrate holder is rotated together with the substrate.

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47. A substrate processing apparatus according to claim 40, wherein said liquid introducing portion has a plurality of liquid delivery pumps for delivering the liquid at spaced time intervals.

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48. A substrate processing apparatus comprising:

a substrate holder for holding a substrate;

a member disposed substantially parallel to a surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder; and

a liquid introducing portion for introducing a liquid into a region across which the substrate held by said substrate holder and said member face each other, from laterally of said member;

wherein said member is vertically movable, and wherein while the liquid is being introduced into the region across which the substrate held by said substrate holder and said member face each other, said member is lowered.

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49. A substrate processing apparatus according to claim 48, further comprising:

a member holder for holding said member;

wherein said liquid introducing portion being provided through said member holder or disposed laterally of said member holder.

50. A substrate processing apparatus according to claim 48, further comprising a deaerating device for removing a dissolved gas from the liquid introduced from said liquid introducing portion.

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51. A substrate processing apparatus according to claim 48, wherein said liquid introducing portion has a distal end shaped as a nozzle or a slit.

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52. A substrate processing apparatus according to claim 48, wherein said liquid introducing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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53. A substrate processing apparatus according to claim 48, wherein said liquid introducing portion is disposed in positions facing each other across the substrate held by said substrate holder.

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54. A substrate processing apparatus according to claim 48, wherein said substrate holder is rotatable, and the liquid is introduced from said liquid introducing portion while said substrate holder is rotated together with the substrate.

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55. A substrate processing apparatus according to claim 48, wherein said liquid introducing portion has a

plurality of liquid delivery pumps for delivering the liquid at spaced time intervals.

56. A substrate processing apparatus comprising:

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a substrate holder for holding a substrate;

a member disposed substantially parallel to a surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder; and

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a liquid introducing portion having a check valve disposed therein or a porous member filled therein, for introducing a liquid into a region across which the substrate held by said substrate holder and said member face each other, from laterally of said member.

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57. A substrate processing apparatus according to claim 56, further comprising:

a member holder for holding said member;

wherein said liquid introducing portion is provided

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through said member holder or disposed laterally of said member holder.

58. A substrate processing apparatus according to claim 56, further comprising:

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a deaerating device for removing a dissolved gas from the liquid introduced, from said liquid introducing portion.

59. A substrate processing apparatus according to claim 56, wherein said liquid introducing portion has a distal end shaped as a nozzle or a slit.

5 60. A substrate processing apparatus according to claim 56, wherein said liquid introducing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

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61. A substrate processing apparatus according to claim 56, wherein said liquid introducing portion is disposed in positions facing each other across the substrate held by said substrate holder.

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62. A substrate processing apparatus according to claim 56, wherein said substrate holder is rotatable, and the liquid is introduced from said liquid introducing portion while said substrate holder is rotated in together
20 with the substrate.

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63. A substrate processing apparatus according to claim 56, wherein said liquid introducing portion has a plurality of liquid delivery pumps for delivering the liquid
25 at spaced time intervals.

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64. A substrate processing apparatus comprising:
a substrate holder for holding a substrate;

a member disposed substantially parallel to a surface, to be processed, of the substrate in a position facing the surface, to be processed, of the substrate held by said substrate holder; and

5 a liquid circulating system having a liquid introducing portion for introducing a liquid into a region across which the substrate held by said substrate holder and said member face each other, from laterally of said member, and a liquid drawing portion for drawing for circulation the
10 liquid from laterally of said member.

65. A substrate processing apparatus according to claim 64, further comprising:

a member holder for holding said member;
15 wherein at least one of said liquid introducing portion and said liquid drawing portion is provided through said member holder or disposed laterally of said member holder.

20 66. A substrate processing apparatus according to claim 64, wherein said liquid circulating system has a deaerating device for removing a dissolved gas from the liquid in circulation.

25 67. A substrate processing apparatus according to claim 64, wherein said liquid introducing portion and/or said liquid drawing portion has a distal end shaped as a nozzle or a slit.

68. A substrate processing apparatus according to claim 64, wherein a check valve is disposed in said liquid introducing portion or a porous member is filled in said liquid introducing portion.

69. A substrate processing apparatus according to claim 64, wherein at least one of said liquid introducing portion and said liquid drawing portion is disposed in positions along the circumferential direction of a peripheral edge of the substrate held by said substrate holder.

70. A substrate processing apparatus according to claim 64, wherein said liquid introducing portion and said liquid drawing portion are disposed in positions facing each other across the substrate held by said substrate holder.

71. A plating method comprising:
placing an anode in facing relation to a surface of a substrate which has an interconnect recess covered with an electrically conductive layer;

filling a region between said substrate and said anode with a plating solution having a uniform high-speed flow over the entire surface of the substrate; and

applying a voltage between said substrate and said anode to deposit a plated film on the surface of said electrically conductive layer.

72. A plating method according to claim 71, wherein said high-speed flow of the plating solution has a speed in the range from 0.5 to 10 m/sec.

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73. A plating method according to claim 71, wherein said substrate and said anode are kept out of contact with each other and spaced from each other by 10 mm or less.

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74. A plating method according to claim 71, wherein a high resistance structure is disposed between said substrate and said anode.

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75. A plating method according to claim 74, wherein said substrate and said high resistance structure are kept out of contact with each other and spaced from each other by 10 mm or less.

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76. A plating method according to claim 71, wherein a voltage having a current value in the range from 10 to 50 mA/cm² is applied between said electrically conductive layer and said anode.

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77. A plating method according to claim 71, wherein said interconnect recess comprises a trench and/or a via hole having an opening width or diameter of 10 μm or greater and an aspect ratio of 1 or greater.

78. A plating apparatus comprising:

a substrate holder for holding a substrate having a surface having an interconnect recess covered with an electrically conductive layer;

5 an electrode portion having a cathode for bringing into contact with an electrically conductive layer of the substrate held by said substrate holder to supply current to the electrically conductive layer;

10 an anode disposed in a position facing the surface of the substrate held by said substrate holder;

a plating solution flow forming section for introducing a plating solution between said anode and the surface of the substrate held by said substrate holder and discharging the plating solution therefrom, to form a
15 uniform high-speed flow of the plating solution over the surface of the substrate; and

a power source for applying a voltage between said cathode and said anode.

20 79. A plating apparatus according to claim 78, wherein said plating solution flow forming section has a flow rate controller for controlling the flow rate of the plating solution introduced between said anode and the surface of the substrate held by said substrate holder.

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80. A plating apparatus according to claim 78, wherein said uniform high-speed flow of the plating solution has a speed in the range from 0.5 to 10 m/sec.

81. A plating apparatus according to claim 78, wherein a high resistance structure is disposed between said substrate and said anode.

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82. A plating apparatus according to claim 78, wherein said interconnect recess comprises a trench and/or a via hole having an opening width or diameter of 10 μm or greater and an aspect ratio of 1 or greater.